

Tutorial (1): Formulation

1.

Decision Variables:

(x_1) The mass of exterior paint produced daily [ton]

(x_2) The mass of interior paint produced daily [ton]

Objective function:

$$\text{Max: } Z = 5000x_1 + 4000x_2 \text{ [L.E.]}$$

Constraints:

$$\begin{aligned} 6x_1 + 4x_2 &\leq 24 \text{ [ton]} \\ x_1 + 2x_2 &\leq 6 \text{ [ton]} \\ x_2 - x_1 &\leq 1 \text{ [ton]} \\ x_2 &\leq 2 \text{ [ton]} \end{aligned} \quad ; x_1, x_2 \geq 0$$

2.

(x_1) The weight of corn used daily [lb]

(x_2) The weight of soybean used daily [lb]

$$\text{Min: } Z = 0.3x_1 + 0.9x_2 \text{ [L.E.]}$$

$$\text{s.t: } x_1 + x_2 \geq 800 \text{ [lb]} \quad ; x_1, x_2 \geq 0$$

$$0.09x_1 + 0.6x_2 \geq 0.3(x_1 + x_2) \text{ [lb]}$$

$$0.02x_1 + 0.06x_2 \leq 0.05(x_1 + x_2) \text{ [lb]}$$

3.

(x_1) Value of Personal loans [L.E.]

(x_2) Value of Car loans [L.E.]

(x_3) Value of home loans [L.E.]

(x_4) Value of farm loans [L.E.]

(x_5) Value of commercial loans [L.E.]

Interest revenue = Interest rate $\times$ real loan which has interest rate

$$\text{Max: } Z = [(0.14 \times 0.9) - 0.1]x_1 + [(0.13 \times 0.93) - 0.07]x_2 + [(0.12 \times 0.97) - 0.03]x_3$$

$$+ [(0.125 \times 0.95) - 0.05]x_4 + [(0.1 \times 0.98) - 0.02]x_5$$

$$\text{s.t: } x_1 + x_2 + x_3 + x_4 + x_5 \leq 12,000,000$$

$$0.4x_4 + x_5 \geq 0.4(x_1 + x_2 + x_3 + x_4 + x_5)$$

$$x_1x_3 \geq 0.5(x_1 + x_2 + x_3)$$

$$0.1x_1 + 0.07x_2 + 0.03x_3 + 0.05x_4 + 0.02x_5 \leq 0.04(x_1 + x_2 + x_3 + x_4 + x_5)$$

$$x_1, x_2, x_3, x_4, x_5 \geq 0$$

4.

(x₁) The number of 100 feet of pipe type (1) produced weekly(x₂) The number of 100 feet of pipe type (2) produced weekly

$$\text{Max: } Z = 34x_1 + 40x_2 \quad [\text{L.E.}]$$

$$\text{s.t.: } 4x_1 + 6x_2 \leq 48 \quad [\text{hr}] \quad ; x_1, x_2 \geq 0$$

$$2x_1 + 2x_2 \leq 18 \quad [\text{hr}]$$

$$2x_1 + x_2 \leq 16 \quad [\text{lb}]$$

5.

(x₁) Number of times of performing flight works daily(x₂) Number of times of serving seatles daily (flight) [hr]

$$\text{Max: } Z = 2500x_1 + 2000x_2 \quad [\$]$$

$$\text{s.t.: } (x_1 + x_2) (11) \leq 12 \quad [\text{hr}]$$

$$15x_1 + 10x_2 \leq 150 \quad [\text{hr}]$$

$$x_1 \leq 9 \quad [\text{flights}]$$

$$x_1, x_2 \geq 0$$

6. x₁(x₁) No. of crab cakes prepared(x₂) No. of seafood prepared

$$\text{Min: } Z = 0.3x_1 + 0.2x_2$$

$$\text{s.t.: } 0.02x_1 + 0.04x_2 \geq 20 \quad [\text{pound}]$$

$$x_1 + x_2 \geq 750$$

7.

(x_1) Quantity of produced microcomputers of type (1) daily

(x_2) Quantity of produced microcomputers of type (2) daily

$$\text{Max: } Z = 60x_1 + 50x_2$$

$$\text{s.t.: } 4x_1 + 10x_2 \leq 100 \quad [\text{hr}]$$

$$2x_1 + x_2 \leq 22 \quad [\text{hr}]$$

$$3x_1 + 3x_2 \leq 39 \quad [\text{ft}^3]$$

$$x_1, x_2 \geq 0$$

8.

(x_1) Quantity of building & selling home model (A)

(x_2) Quantity of building & selling home model (B)

$$\text{Max: } Z = 3000x_1 + 6000x_2 \quad [\text{L.E.}]$$

$$\text{s.t.: } 4000x_1 + 10000x_2 \leq 400,000 \quad [\text{hr}]$$

$$2x_1 + 3x_2 \leq 150 \quad [\text{ton}]$$

$$2000x_1 + 2000x_2 \leq 200,000 \quad [\text{ft}^3]$$

$$x_1, x_2 \geq 0$$

9.

(x_1) Weight of blended alloy (1) [Kg]

(x_2) Weight of blended alloy (2) [Kg]

(x_3) Weight of blended alloy (3)

(x_4) Weight of blended alloy (4)

(x_5) Weight of blended alloy (5)

$$\text{Min: } Z = 22x_1 + 20x_2 + 25x_3 + 24x_4 + 27x_5 \quad [\text{L.E.}]$$

$$\text{s.t.: } 60x_1 + 25x_2 + 45x_3 + 20x_4 + 50x_5 = 40 \quad [\%]$$

$$10x_1 + 15x_2 + 45x_3 + 50x_4 + 40x_5 = 35 \quad [\%]$$

$$30x_1 + 60x_2 + 10x_3 + 30x_4 + 10x_5 = 25 \quad [\%]$$

$$x_1, x_2, x_3, x_4, x_5 \geq 0$$

10.

(x_{ij}) Time of working for operator (i) on day (j) [hr]

(i) = K.C., D.H., H.B., S.C., K.S., N.K.

(j) = Sun, Mon., Tue., Wed., Thu

$$\text{Min: } Z = 10 \sum_{j=\text{Sun.}}^{\text{Thu.}} x_{K.C.,j} + 10.1 \sum_{j=\text{Sun.}}^{\text{Thu.}} x_{D.H.,j} + 9.9 \sum_{j=\text{Sun.}}^{\text{Thu.}} x_{H.B.,j} + 9.8 \sum_{j=\text{Sun.}}^{\text{Thu.}} x_{S.C.,j} \\ + 10.8 \sum_{j=\text{Sun.}}^{\text{Thu.}} x_{K.S.,j} + 11.3 \sum_{j=\text{Sun.}}^{\text{Thu.}} x_{N.K.,j}$$

$$\text{s.t: } \sum_{j=\text{Sun.}}^{\text{Thu.}} x_{ij} \geq 8 \quad \forall i = K.C., D.H., H.B., S.C.$$

$$\sum_{j=\text{Sun.}}^{\text{Thu.}} x_{ij} \geq 7 \quad \forall i = K.S., N.K.$$

$$x_{K.C., \text{Sun.}} \leq 6, x_{K.C., \text{Mon.}} \leq 0, x_{K.C., \text{Tue.}} \leq 6, x_{K.C., \text{Wed.}} \leq 0, x_{K.C., \text{Thu.}} \leq 6$$

$$x_{D.H., \text{Sun.}} \leq 0, x_{D.H., \text{Mon.}} \leq 6, x_{D.H., \text{Tue.}} \leq 0, x_{D.H., \text{Wed.}} \leq 6, x_{D.H., \text{Thu.}} \leq 0$$

$$x_{H.B., \text{Sun.}} \leq 4, x_{H.B., \text{Mon.}} \leq 8, x_{H.B., \text{Tue.}} \leq 4, x_{H.B., \text{Wed.}} \leq 6, x_{H.B., \text{Thu.}} \leq 4$$

$$x_{S.C., \text{Sun.}} \leq 5, x_{S.C., \text{Mon.}} \leq 5, x_{S.C., \text{Tue.}} \leq 5, x_{S.C., \text{Wed.}} \leq 0, x_{S.C., \text{Thu.}} \leq 5$$

$$x_{K.S., \text{Sun.}} \leq 3, x_{K.S., \text{Mon.}} \leq 0, x_{K.S., \text{Tue.}} \leq 3, x_{K.S., \text{Wed.}} \leq 8, x_{K.S., \text{Thu.}} \leq 0$$

$$x_{N.K., \text{Sun.}} \leq 0, x_{N.K., \text{Mon.}} \leq 0, x_{N.K., \text{Tue.}} \leq 0, x_{N.K., \text{Wed.}} \leq 0, x_{N.K., \text{Thu.}} \leq 2$$

11.

(x_1) No. of cars distributed from Los Angeles to Denver

(x_2) No. of cars distributed from Los Angeles to Miami

(x_3) No. of cars distributed from Detroit to Denver

(x_4) No. of cars distributed from Detroit to Miami

(x_5) No. of cars distributed from New Orleans to Denver

(x_6) No. of cars distributed from New Orleans to Miami

$$\text{Min: } Z = 8(1000x_1 + 2600x_2 + 1250x_3 + 1350x_4 + 1275x_5 + 850x_6) \text{ [cent]}$$

$$\text{s.t: } x_1 + x_2 \leq 1000 \text{ [car]} \quad 100 \text{ [car]}$$

$$x_3 + x_4 \leq 1500 \text{ [car]} \quad 100 \text{ [car]}$$

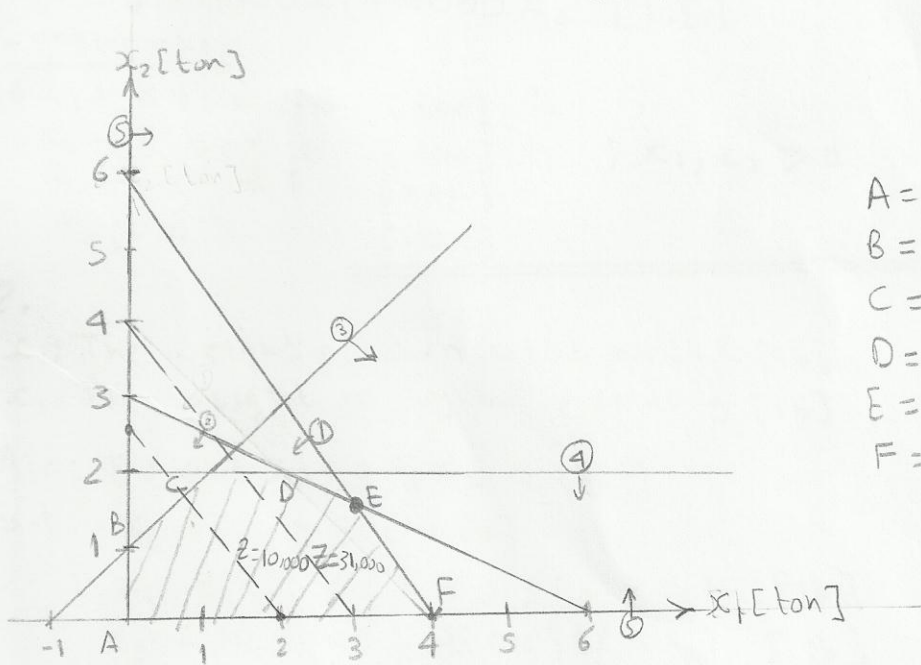
$$x_5 + x_6 \leq 1200 \text{ [car]} \quad 100 \text{ [car]}$$

$$x_1 + x_3 + x_5 \geq 2300 \text{ [car]} \geq 2300 \text{ [car]}$$

$$x_2 + x_4 + x_6 \geq 1400 \text{ [car]}$$

Tutorial 1.1: Graphical Solution

1. Max. $Z = 5000x_1 + 4000x_2$ [L.E.]
s.t. $6x_1 + 4x_2 \leq 24$ [ton] $\leftarrow (1)$
 $x_1 + 2x_2 \leq 6$ [ton] $\leftarrow (2)$
 $x_2 - x_1 \leq 1$ [ton] $\leftarrow (3)$
 $x_2 \leq 2$ [ton] $\leftarrow (4)$
 $x_1, x_2 \geq 0$ [ton] $\leftarrow (5)$



$$A = (0, 0)$$

$$B = (0, 1)$$

$$C = (1, 2)$$

$$D = (2, 2)$$

$$E = (3, \frac{3}{2})$$

$$F = (4, 0)$$

(Z) is max. at $(E) \Rightarrow Z_{\max.} = Z(3, \frac{3}{2}) = 5000(3) + 4000(\frac{3}{2}) = 21000$ L.E.